over the wire and work at a valuation, or arranging for the incoming tenant's doing so. The pasture, particularly under larch, is much better than elsewhere, and the trees afford shelter for the sheep from the excessive cold in the winter (as they would in India from the excessive heat in the hot weather on the plains, and on the hills from the rain and cold winds), whilst, on the other hand, the landlord gets an enhanced rent, and has his fences put up and kept in repair.

From young plantations or natural woods all men and cattle are rigidly excluded, as well as from tracts from which a crop of timber has recently been removed, and which, according to Mr. Thomson's system, is allowed to lie entirely fallow for some time. It often happens, however, that enclosures are made, or exist, before the forest establishments are ready to plant them. In these cases the grazing is rented, and often goes a long way to pay for the fencing. I trust we may yet arrive at some such system in India, allowing, of course, a wide margin for the people's actual requirements in the shape of grazing for their cattle, sheep, and goats, but not hesitating to take up, for planting or reserve, any of the residue which may be required to be thrown open again, or rented, as thought fit, when the trees have grown out of harm's way.

Explanatory Memorandum of Plates II. and III.

Vertical Saw Mill worked by Water Power.

This is effected in the following manner (see transverse and longitudinal sections) :—

Water is led along the shoot *M* on to the breast wheel *I*, acting on it partly by weight and partly by impulse, and escaping under the wheel. The wheel, in revolving, communicates motion to the crank *G*, which is attached to the driving rod *F*. This rod is secured to the bottom cross-head *C*, *D*, of the saw frame *A*, *B*, *C*, *D*. This frame works in guides, and it will be seen that the revolutions of the water wheel communicate vertical motion to the saw *E*, which is firmly secured to the cross-heads of the frame.

The beam to be sawn travels on a carriage *K*, to which slow motion is communicated by means of the rods *E* and *L*, the roller *H*, the toothed wheel *D*, and the cord *N*. This is so apparent from an inspection of the figure, that no detailed description is necessary.

The ratchet *O* falls into its place in the circumference of the toothed wheel *D* at each stroke of the saw, and thus keeps the wheel in its place.

The Earl of Mansfield's Woods, &c. at Scone, Perthshire, N.B.

These woods extend over about 10,000 acres, and are under the management of Mr. M'Corquodale, one of the most experienced of wood managers in this country, who has held the post for upwards of thirty years. He is aided by nine district foresters, and a considerable staff of permanently employed woodmen.

The country differs greatly from Strathspey, and even Blair Athole, as it is highly cultivated, and there are no extensive moorlands or pasture farms.

The plantations are therefore small in comparison, and in many cases extend over only a few acres, being surrounded by land under the plough.

This involves great expenditure in the formation and maintenance of the fences.

Mr. M'Corquodale informs me that he has no less than 600 miles of fencing to keep up, which of course includes the farm fences maintained by the proprietor. The soil being much richer than that of Strathspey, the growth of trees is more luxuriant. Mixed hardwood plantations were formerly extensively formed on the property, and the oak was looked upon as the standard and most valuable tree to grow; but this is now changed, and the conifers are receiving most attention, and appear likely to be the best paying crop, besides being the most useful for general estate purposes.

Nurseries.—There are two nurseries, one situated at Scone (about one acre), and another (two acres) at Logie Almond.

They are arranged in the manner already described, and appear in excellent order, containing seedlings and transplanted trees of the several descriptions of hardwood and *coniferæ*.

Amongst the former I was struck with the oaks and sycamores, some beds of which average fully eight feet in height, being retained in the nurseries for avenue planting, which I saw being carried on in the neighbourhood of Logie Almond.

Mr. M'Corquodale tells me they have no difficulty, and few losses, in planting out such large trees, which are two-years seedlings thrice transplanted, *i.e.*, five years old before being put out,—as the roots are rendered very healthy and fibrous by the frequent transplanting, and soon shoot out in the pits which are 40 inches square.

Another noteworthy feature in the nurseries is the fine stock of *P. Douglasii* of all ages. Mr. M'Corquodale has given this tree much attention, and speaks very highly of it, both for ornamental purposes and planting to profit. At Loch Almond there are a few *Abies Nordmaniana* seedlings, which promise well as ornamental trees for the policy grounds.

Mr. M'Corquodale showed me a bed which had been sown with Indian (Himalayan) tree seeds, sent to him by Dr. Cleghorn. They comprised *Pinus excelsa, Cedrus deodara, Abies Smithiana,* and *Picea Webbiana.*

The *Pinus excelsa* had germinated fairly, but of the other descriptions few have come up at all. Greater care would appear to be necessary in selecting and packing the seed.

Mr. M'Corquodale is very willing to experiment with all descriptions of Indian tree seeds, and great attention is paid to the sowing and transplanting so as to ensure success, if possible.

Plantations.—I visited nine plantations or places where planting operations had been or were being carried on.

The oldest trees which I include under this head are, in this case, 25 years old, and average from 35 to 40 feet in height. A small plantation (22 acres) of Scotch fir of this age was visited by Dr. Brandis five or six years ago. Dr. Brandis then considered it too thin, but since then it has been twice thinned, and, according to the system pursued in this county, does not appear too thin now.

Mr. M'Corquodale lays it down as a rule, that the average distance between trees in a plantation should be one third their height. Thus, if trees average 30 feet high they should stand at 10 feet apart, and so on.

He showed me a very simple method of estimating the height of trees by the eye, which I think will be useful in India in making forest valuation surveys, &c.

The second plantation which I visited was a pinetum with larch nurses, being a portion of a 55-acre enclosure. The trees are about 20 years old, and comprise *Menziesii, Laricio, Austriaca, nobilis,* and *excelsa.* The *Menziesii* shows by far the finest growth, the next best being the *Laricio,* which shoots up rapidly, but presents a bare appearance. The black *Austriaca* are very robust, but coarse in their habit.

There is a considerable quantity of *P. montana,* a dwarf species planted for underwood as cover for game.

Mr. M'Corquodale intends gradually removing all the larch, and leaving the pine plantation as an experiment,

using the thinnings for posts, &c. on the property to test the value of the several descriptions.

Near this is a 13-acre plantation of the Douglas pine planted out 10 years ago, as two years seedlings two transplanted.

They are planted in pits 15 feet apart, 15 inches square, and 10 inches deep, with larch and Scotch fir nurses at about four feet apart.

The Douglas pines are doing very well, and average fully 25 feet in height.

The nurses are now being gradually removed.

The pits cost 4*s.* per acre, containing about two hundred.

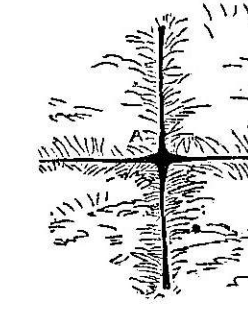
At Lynedoch we inspected a mixed plantation of Scotch fir, larch, and spruce, all doing fairly, and on an adjoining piece of moorland I had a favourable opportunity of seeing draining and planting operations in progress.

The drains were 36 feet apart, 2 feet deep, 2½ feet wide at top, and a spade's width (or about 1 foot) at bottom, the main drain being 3 feet deep, and 3½ feet wide at top.

The land is very spongy, with a clay soil at top, but gravel is reached at two feet from the surface. It is being planted with Douglas pines in pits, as already described, and made up with larch at about six feet, and Scotch fir at about three feet apart.

The nurses were being put in on what Mr. M'Corquodale terms the "double notch system," an idea of his own which he finds efficacious in fixing the young tree very firmly in the ground.

It consists in making two cross cuts with the spade instead of one, as is usual, canting by a turn of the wrist a portion of the turf a little to one side on making the second cut, introducing the plant at A, and passing it along to B, then treading the turf well down all round.



The men do this very quickly after a little practice, and the plan seems a very good one.

As already stated, Mr. M'Corquodale does not consider it impossible to re-plant land from which a crop of timber has

been recently removed, and does not agree with Mr. Grant Thomson that it is necessary to wait until the natural herbage or vegetation returns; but he does consider, that in order to plant such land successfully, special treatment is necessary.

He appears to have given the matter much attention, and has arrived at the conclusion that it is the beetle, and the beetle only, which interferes with the growth of young trees planted on land recently cleared of conifers. He has contributed several papers on the subject to the Scotch Arboricultural Society, and tried various methods for overcoming the difficulty, arriving at last at the following, which he has now no hesitation in recommending.

Allow the land to lie entirely waste for one year, excluding all cattle and sheep, in order to allow grass, &c. to grow. Then burn it when dry, and plant out by the double notching system.

This plan should not cost more than 15*s.* per acre, all told, and the saving by not allowing the land to lie waste for a number of years, as in Strathspey, is very considerable.

Mr. M'Corquodale also succeeded in raising the young trees, after a "clean cut," by burning and pitting, but this was too expensive, amounting, in one instance, to 45*s.* per acre. I saw plantations of both descriptions, and can vouch for the trees being healthy, and having attained to heights of 30 and 35 feet in 24 years, and from the one last alluded to as pitted 40*l.* was realized last year by thinning 20 acres. This plantation was originally very unfortunate, 32,000 young trees having been "thrown out" of the ground by severe frost during their first winter, which raised the expenditure to 45*s.* per acre, as already stated.

The other plantations visited do not demand special notice, save a fine piece of Scotch fir, extending over 60 acres. This was planted about 20 years ago, and the trees, which now stand eight or nine feet apart, average fully 30 feet high. The thinning of this wood, two years ago, realised 60*l.*, and it will be thinned again next year.

Woods.—In the Policy Grounds adjoining Scone Palace and Logie Almond are some very fine specimens of *P. Douglasii, Menziesii, nobilis,* and *excelsa* (Indian), and old Scotch firs and beech of great size.

Close to Scone there is an oak wood, with hazel undergrowth, containing some very fine trees, one of which was measured two years ago by Captain Douglas and Mr. M'Corquodale, and found to contain upwards of 100 cubic feet of

timber, being then 63 years old, and there are many nearly as good in the vicinity. Mr. Brown appears to have measured this same tree in 1850, and found it to contain 48 cubic feet, and if this is correct, and the measurements were both conducted on the same system, it appears that the cubical contents has more than doubled in 13 years, which is very remarkable.

In another wood of 30 acres, 50 years old, mixed hardwoods and larch, the growth of the former is very fine, but I did not obtain any measurements.

There is a considerable extent of oak coppice on the estate, but the rates now realized by sales are not remunerative, and Mr. M'Corquodale is therefore not extending it, but prefers keeping the best oaks as standards and planting Scotch firs.

I saw several oak trees of various ages pruned, and the selection of Scotch fir and spruce to be felled in an old wood.

Timber here realizes rather more remunerative rates than Strathspey or Dunkeld, as the woods are close to a market at Perth, and the surrounding country is highly cultivated.

Fencing.—Mr. M'Corquodale's wire fences, which are very substantial, cost him only 6*d.* per running yard. He has a greater command of labour than Mr. Grant Thomson, and the carriage of the wire is less. He states that he seldom uses the "collar" to hold the wire when straining, finding an iron wedge sufficient. He uses the strainer referred to in the report on Strathspey, which he finds the best.

Saw Machinery.—I inspected a portable steam-engine at work for a wood merchant, who spoke very highly of its work, and stated that he had had the same engine at work for several years in different places.

This engine is by Abernethy of Aberdeen, 20-horse power, with 15-inch cylinders on the same principle as that of Chrystie of Perth, of which I have obtained plans and specifications. It is adapted for burning wood chips and shavings, the refuse of the trunks sawn up.

The Duke of Athole's Woods and Plantations at Blair Athole and Dunkeld, Perthshire, N.B.

I spent several days in visiting these woods, and met with great attention from Mr. M'Gregor, the Duke of Athole's wood manager.

The woodlands extend to upwards of 10,000 acres, divided into five districts (including Strathord, which is detached from the rest), each under a separate forester.

The first systematic planting was commenced in 1728, by Duke James, who caused extensive plantations of larch and spruce, particularly the former, to be formed; and, until a comparatively recent date, these descriptions were mainly planted without much consideration as to the nature of soil and exposure. The Scotch fir has, however, been largely introduced during the past 50 years, and, as a rule, appears better suited to the soil and climate. Here and there the larch has done very well, and surpasses anything of that description in Strathspey.

The Nurseries at Ladywell adjoin Mr. M'Gregor's house, and cover about four acres. They are well stocked with young trees, both hard-wood and coniferous. Amongst the former, the sycamores (*Acer pseudo-platanus*) are particularly fine, being grown for avenues, transplanted in the nurseries for several years, and put out 10 and 12 feet in height.

There is another small nursery at Blair, near the castle, in which seedlings for that district are reared.

Plantations.—I visited six plantations; they are mostly of small extent. The great difficulty which Mr. M'Gregor has to contend against is game, particularly rabbits, hares, and fallow deer. The only plans to adopt would be those carried on by Mr. M'Corquodale at Scone, viz., wire netting round the fences, and "cradles" or other protection to each tree; but anything of this sort adds considerably to the expense, and can never be generally adopted in extensive planting operations. The truth of the saying that "you cannot rear "both young trees and game at the same time" is fully corroborated in the case of the Duke's estate.

At Blair some 300 acres are now being planted with Scotch fir and larch; and in an old larch plantation, which has been thinned out to about 150 or 200 trees to the acre, the plan of slitting in larch and Scotch fir as a second crop is being tried.

Near Dunkeld, 100 acres of Scotch firs, mixed with a few oaks as standards, planted some years ago, are doing fairly, but has a patchy appearance owing to its being overrun with game, particularly fallow deer. In another place there are 36 acres of mixed hard-wood and Scotch fir, which is doubly enclosed, and now doing pretty well, but has been twice replanted owing to the devastation caused by game. An adjoining piece of 170 acres has not been planted up, as Mr. M'Gregor sees little use in doing so unless the rabbits and hares are shot down. In the same block, 22 acres of old wood has been left standing as a screen, and in the hope of natural reproduction, which, it is worthy of note, the game do not attack so much as trees planted out from the nurseries; probably because, in the former case, the young trees come up very gradually, and do not attract the attention of their deadly foe, the rabbit, so much as those which are put out 8 or 10 inches high.

In a plantation about 20 years old behind Mr. M'Gregor's house, the larch are much affected by disease, both blister and dry rot, and cannot be said to be thriving. The Scotch fir in the same plantation is healthy; the trees average 18 to 20 feet in height.

Close by is a mixed hard wood and Scotch fir plantation, in which the former, particularly the sycamores, are doing well; but here again, and in a large tract of 350 acres which I saw the same day, the damage done by the game is great.

Self-sown Fir.—I only saw one piece of about 10 acres, and Mr. M'Gregor informs me that it is the only one on the property, excepting a small piece at Strathord.

There is a considerable quantity of self-sown or indigenous birch, which is sold by weight at from 6*s.* to 10*s.* per ton, dragging and carting expenses, and, in some cases, the cutting being borne by the purchaser. The wood is much used for the manufacture of bobbins and the refuse for charcoal.

Woods.—These are mainly larch, for which Duke James and his immediate successors had a great predilection. It has in many cases been planted in unsuitable soil, where the Scotch fir would have done much better, and yielded a much better return. The Duke's idea appears to have been to make use of it for ship-building, after floating down the Tay to Newburgh, and thence to Dundee. I believe only one man-of-war, a frigate called "The Athole," was ever constructed of it, but do not know how it answered.

The disease which has attacked the larch within the last 30 or 40 years, the great fall in price owing to its disuse for ship-building, the introduction of foreign timber in large quantities, and more recently the substitution for many purposes of iron for wood, has falsified all the calculations as to the value of these woods, so much so that what was estimated to be worth 1,000*l.* per acre when mature would not now realize more than 150*l.* to 200*l.*

The disease to which I have alluded does not appear to have existed until within the last 30 or 40 years, but is now very common, in fact universal, and there would appear to be no remedy for it short of cutting out all diseased trees and replanting; even then it is doubtful whether it will not reappear in the new crop. It is said to be atmospheric, and first makes its appearance in a fungus-like growth on the stem of the tree, generally near the axils of the branches, then developes itself into or produces a blister, and eventually a hole or wound as if a branch had been roughly broken off.

There is a fine larch wood, extending to 3,000 acres behind and above Dunkeld, and covering the whole of Duchray Hill, to the top of which we ascended (1,600 feet above the sea). This extensive forest has now been cleared out to an average of 100 trees per acre, and those near the base of the hill are very fine and healthy. On the higher slopes the growth is superior, and there appears little doubt that the Scotch fir is much better adapted for such exposed situations. There is a good deal of spruce in the hollows, which does not as a rule present a healthy appearance, little regard having in former years been paid to drainage. On the opposite hills a tract of almost equal extent was planted, but it has not done nearly so well.

Above Inver there is a wood known as Craigvinean, extending over 800 to 1,000 acres of larch and spruce, with a little Scotch fir, which is the finest I saw on the estate. It has been thinned out to 150 to 200 trees per acre, and a little thinning of "back-going trees" (that is, those which have passed their prime) is now going on.

In the Policy Grounds at Castle Blair there are some very fine specimens of larch trees over 100 years old, and some of the original Scotch firs planted in 1738. Both descriptions are of great size but of straggling habit, not having been trained as in regular crop. The grounds also contain some fine specimens of the *P. Douglasii*, *P. nobilis*, *P. pectinata*, *Cupressus Lawsoniana*, *C. torulosa*, &c., and

near the "Hermitage" at Dunkeld are some very fine Scotch firs and specimens of *Abies Mexicana, Menziesii*, &c.

Mr. M'Gregor approves of and carries on the removal of the dead lower branches from the larch, which he finds can best be done in very dry clear weather, whether warm or frosty, as the branches are then brittle. He does not practise this system with the Scotch fir or spruce.

The methods of thinning, cutting (by cross-cut saw), and sales do not differ materially from those in force in Strathspey, and the classes into which the trees are divided, viz., timber, spars, and props are identical, but Mr. M'Gregor adds a fourth class of thinnings under 3 inch diameter, for which he finds a sale. He gives the average rates as follows:—

Larch—timbers, 1*s.* per cubic foot.
„ spars, 2*d.* per running foot, measured lineally to 6-inch diameter.
„ props, 4*s.* 6*d.* per 100 running feet, measured lineally to 3-inch diameter (or a little over ½*d.* per foot).
„ 4th class (as above), 2*d.* to 4*d.* each, according to situation.

Note.—Larch bark, which is used for dressing sheepskins for satchels, bookbinding, &c., realises about 3*l.* per ton.

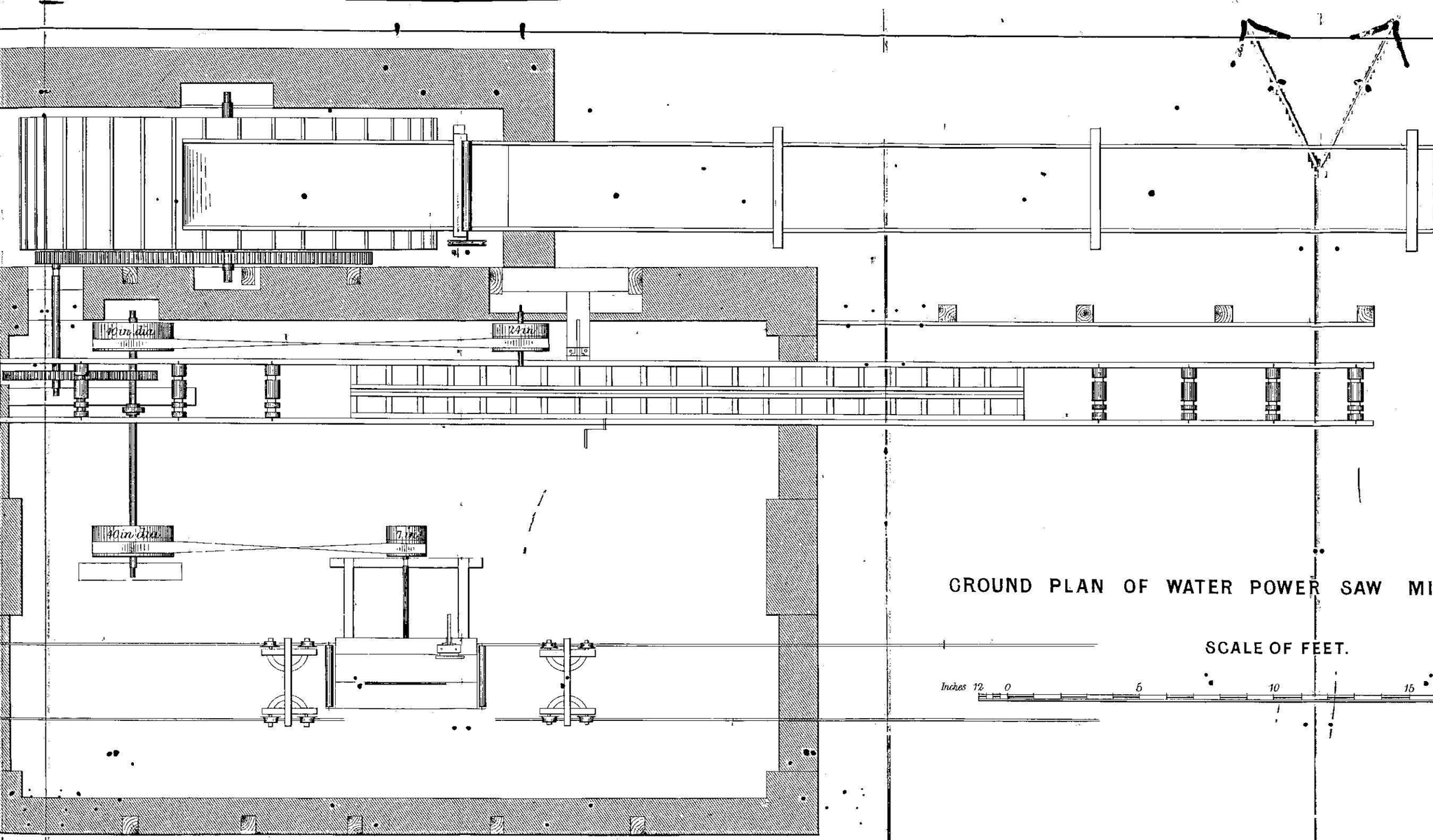
Scotch Fir.—Timber, 8*d.* per cubic foot.
„ Spars, 1¼*d.* per lineal foot.
„ Props, 2*s.* 6*d.* per 100 feet.

Spruce used to realise about the same, but has been reduced to 5*d.* or 6*d.* per cubic foot to effect sales.

Oak Woods and Coppice.—There are about 1,200 acres under oak, of which I visited several tracts. The oak coppice is cut periodically at intervals of from 20 to 25 years, the standard trees, which are not to be felled, being previously marked, and those of any size numbered consecutively.

The average price realized for oak coppice does not now exceed 10*l.* or 12*l.* per acre, including, of course, both the timber and bark (the former does not now fetch more than 1*s.* per cubic foot). Mr. M'Gregor has known it reach 20*l.*, but it was quite an exceptional case. The great fall in price has resulted from other substances being used for tanning, and on account of large importations of foreign bark. The value of the timber has declined, owing to its almost universal supersession by iron for ship-building purposes, for which, in ironclad men-of-war, a teak backing is

Plate IV.



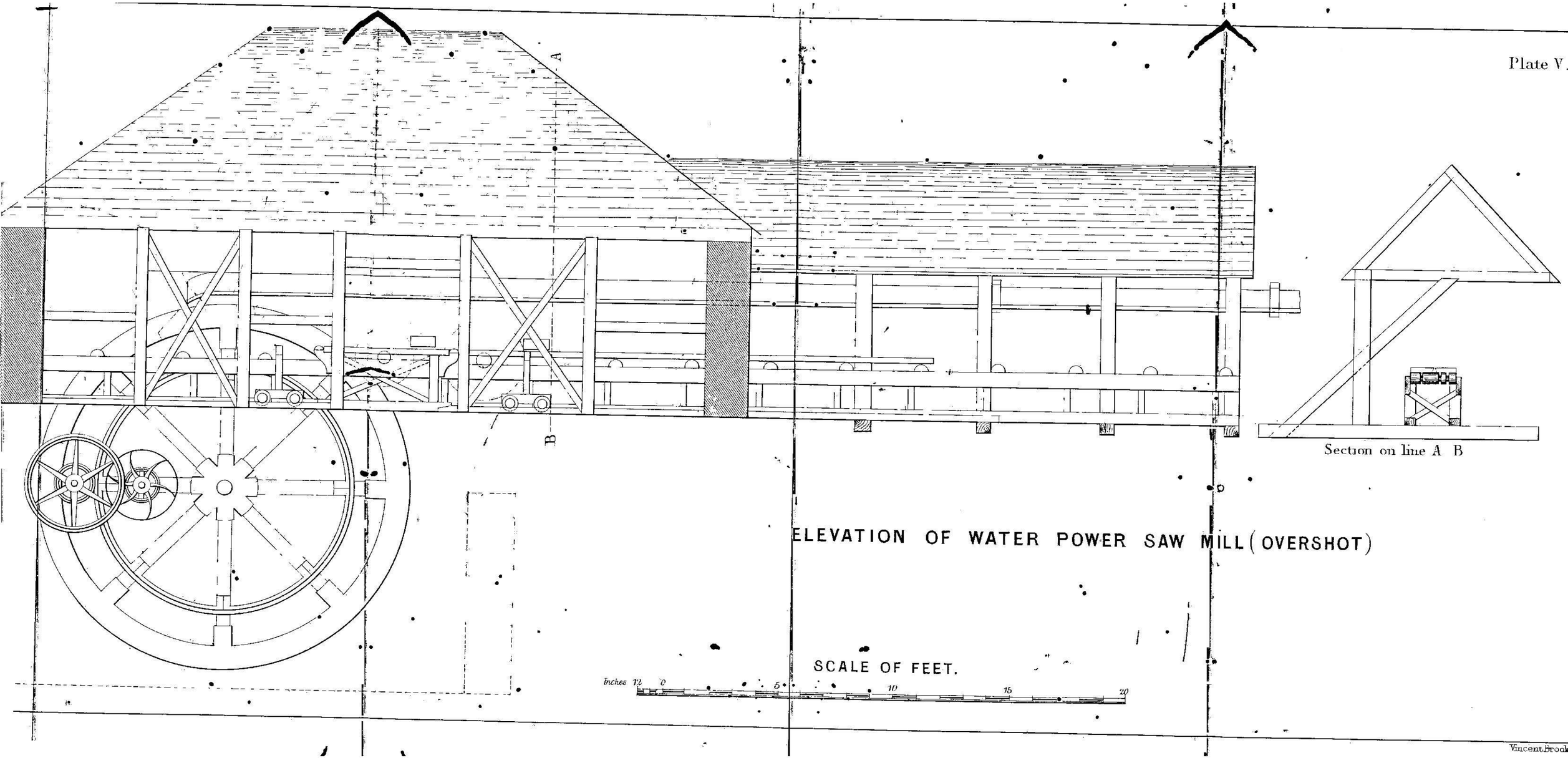
GROUND PLAN OF WATER POWER SAW MILL (OVERSHOT)

SCALE OF FEET.

Inches 12 0 5 10 15 20

Vincent Brooks Day & Son Lith

Plate V.



Vincent Brooks Day

generally preferred. Oak coppice is thus no longer remunerative, and does not receive so much attention as formerly.

Birch, of which there is a considerable quantity, sells, as as already stated, by weight at 6*s.* to 10*s.* per ton.

There is at present little or no supply of other timbers, and the demand for anything, except larch, spruce, and Scotch fir, of which any quantity can be sold, is scarce.

Mr. M'Gregor is surface draining the marshy places in the same manner as described under "Lord Mansfield's Woods."

Wire Fencing.—All now being put up is of wire, with wooden posts, and differs in no material point from that described as adopted at Strathspey, save that here as a rule the work is executed by the regular establishment, and posts are cut up for the purpose, not purchased, which renders the actual cost per running yard difficult to ascertain exactly.

Saw Mills.—I visited four on the Duke's property, viz., three water power and one steam.

Of the three water-power mills, one (close to Blair) is small, and devoted entirely to working up wood for estate purposes. The other two are very powerful, and leased to wood merchants, the proprietor keeping up the machinery. (For specimen working drawings, *see* Plates IV. & V.)

The saw mills were all at work when I was there, and there seems little trouble in their management. They are fitted with long and short benches and appliances for boring holes and fitting ends for hurdles. That at Inver, which I saw last, and which is the most powerful, has also attached a very simple apparatus for crushing the bark and filling sacks with it, which has hitherto been done by manual labour with the aid of flails.